

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Appl.No.: 09/493,526  
Appellant: Shalvi et al  
Filed: January 28, 2000  
TC/AU: 2631  
Examiner: Corielus

Confirmation No.: 2369

Docket: TI-30149  
Cust.No.: 23494

APPELLANTS' BRIEF

Commissioner for Patents  
P.O.Box 1450  
Alexandria VA 22313-1450

Sir:

The attached sheets contain the Rule 41.37 items of appellants' brief. The Commissioner is hereby authorized to charge the fee (\$500.00) for filing a brief in support of the appeal, the fee for a one month's extension of time (separate petition attached), plus any other necessary fees to the deposit account of Texas Instruments Incorporated, account No. 20-0668.

Respectfully submitted,



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Rule 41.37(c)(1)(i) Real party of interest

Texas Instruments Incorporated owns the application.

Rule 41.37(c)(1)(ii) Related appeals and interferences

There are no related dispositive appeals or interferences.

Rule 41.37(c)(1)(iii) Status of claims

Claims 1-3 and 5 are pending in the application with all claims finally rejected. This appeal involves the finally rejected claims.

Rule 41.37(c)(1)(iv) Status of amendments

There is no amendment after final rejection.

Rule 41.37(c)(1)(v) Summary of claimed subject matter

The invention provides a method of coding for upstream transmission in a digital cable system. Application page 4, lines 4-21 describes the coding. And application page 5, line 22 to page 6, line 21 plus Fig.3 illustrate a bit-wise scoring for soft (Viterbi-type) decoding.

Rule 41.37(c)(1)(vi) Grounds of rejection to be reviewed on appeal

The grounds of rejection to be reviewed on appeal are:

- (1) whether claims 1-3 are anticipated by the Vijayan reference.
- (2) whether claim 5 is patentable over the Vijayan reference in view of the Cumberton reference.

Rule 41.37(c)(1)(vii) Arguments

(1) Claims 1-3 were rejected as anticipated by Vijayan; the Examiner pointed to Vijayan Figs.2-3.

Appellants reply that claims 1-3 are limited to coding for upstream transmission in a cable system. In contrast, Vijayan applies to a wireless (air interface) system; see Vijayan column 4, lines 5-21. Because the problems that

coding are to overcome for an upstream in a cable system differ from the problems of wireless systems, Vijayan does not anticipate claims 1-3. In particular, the coding in Vijayan is to counter multipath fading problems of wireless systems; whereas, a cable system has no fading problems but rather impulse and burst noise problems; see Vijayan, column 2, lines 36-41 and the bottom two paragraphs of application page 1.

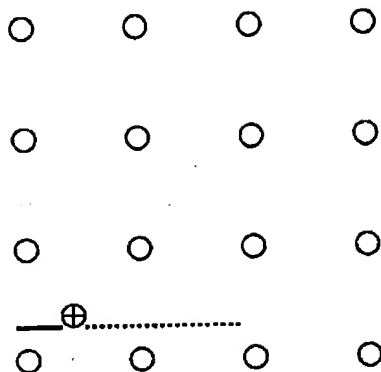
(2) Claim 5 was rejected as unpatentable over Vijayan in view of Cumberton; the Examiner applied Vijayan as in (1) and pointed to Cumberton Fig.9 and column 3, line 48-column 4, line 35 for minimum squared distance scoring (metric used for Viterbi-type decoding).

Appellants reply that claim 5 requires each bit for a received signal (soft QAM symbol) be scored by minimum squared distance to the closest corresponding bit in the QAM constellation; whereas, Cumberton and Vijayan both consider distance to constellation symbols when scoring, not just bits. This can be explained most effectively by illustrating the three different scoring methods (claim 5, Vijayan, and Cumberton) with the example shown in Fig.3 of the application: a 16QAM constellation with each constellation symbol indicated by a  $\bigcirc$  and the received signal to be scored indicated by  $\oplus$ . Each constellation symbol is encoded by 4 bits; e.g., the upper left corner symbol encodes 0100 and the lower right corner symbol encodes 1011.

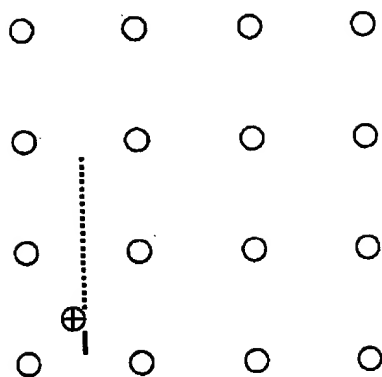
First, the claim 5 scoring (listed on application page 6, middle paragraph) is shown for each bit with a separate constellation; the distance used for the score for the bit to be a 1 is shown as a dotted line and the distance for the score for the bit to be a 0 is shown by a solid line.

Claim 5

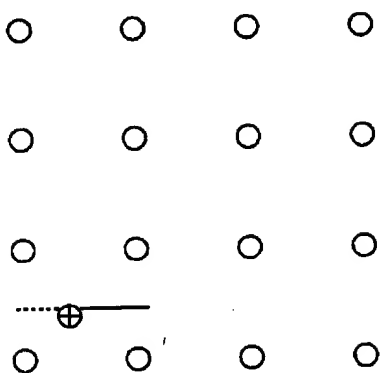
First bit



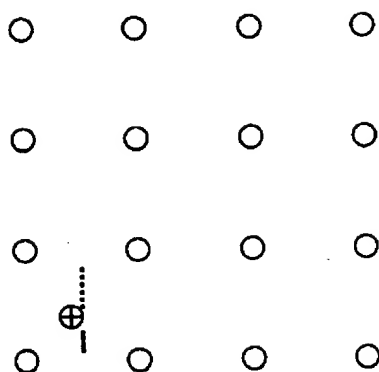
Second bit



Third bit



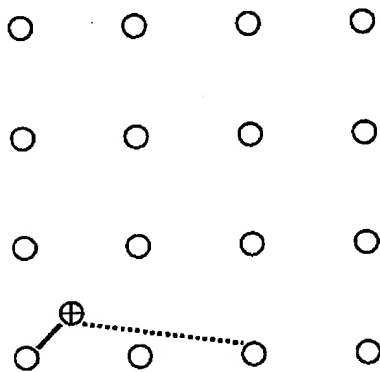
Fourth bit



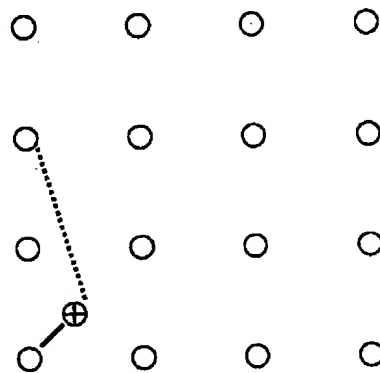
Next, Vijayan scores for a hard decision (not Viterbi-type decoding) for each bit using minimum distance squared to constellation symbols (see Vijayan column 8, line 1), not just the corresponding bit as in claim 5. These distances are again illustrated for the 1 bit with a dotted line and the 0 bit with a solid line.

#### Vijayan reference

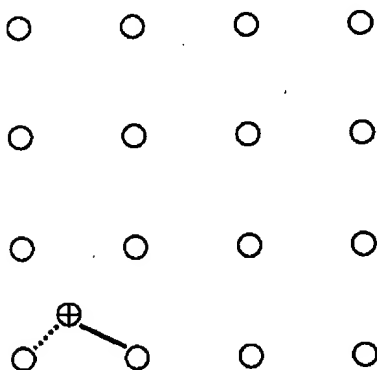
First bit



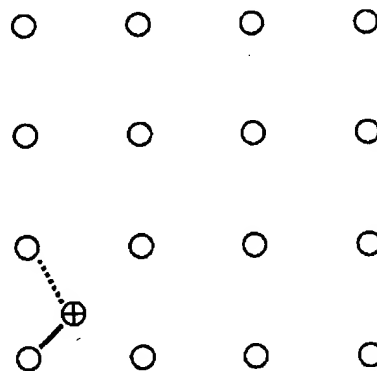
Second bit



Third bit



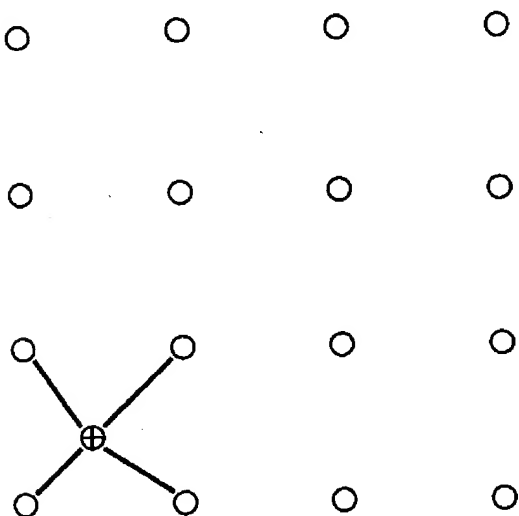
Fourth bit



Lastly, Cumberton also uses squared-distance-to-closest-symbol scoring like Vijayan, but only for the two encoded bits; the other bits are not convolutionally encoded. In particular, each 64QAM symbol of Cumberton (Fig.5) encodes 6 bits of which only two are the result of convolution encoding: Fig.1 shows for 5 input data bits,  $X_1, X_2, X_3, X_4, X_5$ , and  $X_1$  is convolutionally encoded to yield bits  $Y_0$  plus  $Y_1$ , the other 4 bits are systematic bits:  $Y_2 = X_2, Y_3 = X_3, Y_4 = X_4, Y_5 = X_5$ ; see column 3, lines 5-30. Then the four bits  $Y_2, \dots, Y_5$ , determine which of the 16 grid squares of the 64QAM constellation (indicated by grid lines in Fig.5) to use, and the 2 convolutionally encoded bits  $Y_0, Y_1$  determine which of the 4 symbols in the selected grid square to use (table in Fig.5). Fig.9 illustrates decoding which picks the 4 symbols in the constellation closest to the received signal, and uses the corresponding 4 square distances for Viterbi-type decoding (column 4, lines 15-24) of the 2 convolutionally encoded bits and essentially hard decisions for the other 4 bits  $Y_2, \dots, Y_5$ .

Cumberton adapted to the 16QAM example would reduce the 4 hard decision bits  $Y_2, \dots, Y_5$ , to 2 bits  $Y_2, Y_3$  (which would determine the 4 quadrants of the 16QAM constellation) and maintain 2 convolutionally encoded bits  $Y_0, Y_1$ . Then as in Cumberton Fig.9, the decoding for the example would be illustrated with a single constellation for all 4 bits.

Cumberton reference adapted to 16QAM example



The received signal falling into the lower left of the constellation implies that  $Y_2$  decodes as 0 and  $Y_3$  also decodes as 0. The four closest symbols represent  $Y_0Y_1$  pairs of bits of 10 (upper left), 00 (upper right), 11 (lower left), and 01 (lower right), and the corresponding squared distances to the received signal are the incremental scores to use in the Viterbi decoding illustrated in Cumberton Fig.6. Note that Cumberton only has two convolutionally encoded bits per symbol, and these two bits define four possibilities which reflect the four closest symbols.

In short, the references do not suggest the claim 5 bit scoring, and claim 5 is patentable over the references.

Rule 41.37(c)(1)(viii) Claims appendix

1. An encoder for a CATV upstream data channel transmitter, comprising:
  - a convolutional encoder for receiving data values, said convolutional encoder concatenated with an outer Reed-Solomon encoder;
  - a bit interleaver interconnected with said convolutional encoder; and
  - a symbol mapper interconnected with said bit-interleaver.
2. The encoder of claim 1, wherein said symbol mapper is a QAM mapper.
3. A system which comprises:
  - an encoder for a CATV upstream data channel transmitter, comprising:
    - a convolutional encoder for receiving data values, said convolutional encoder concatenated with an outer Reed-Solomon encoder;
    - a bit interleaver interconnected with said convolutional encoder; and
    - a symbol mapper interconnected with said bit interleaver; and
  - a bit-interleaved decoder for a CATV upstream channel receiver, comprising:
    - a scorer for receiving symbols;
    - a bit de-interleaver interconnected with said scorer; and
    - a convolutional decoder interconnected with said bit de-interleaver.
5. A decoding method, comprising:
  - receiving a sequence of soft QAM symbols;
  - scoring each bit for a decoding of a received soft QAM symbol by the minimum squared distance from corresponding symbols of the QAM constellation defined by said each bit to the real or imaginary part of said received soft QAM symbol;
  - de-interleaving said bits subject to said scoring; and
  - convolutionally decoding said de-interleaved bits using results of said scoring.



Rule 41.37(c)(1)(ix) Evidence appendix

N/A

Rule 41.37(c)(1)(x) Related proceedings appendix

N/A